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6.7 Rainwater Harvesting

Rainwater harvesting refers to the collection, storage, and use of rainwater. Most systems use the roof surface as the collection area and a large galvanized steel, fiberglass, polyethylene, or ferro-cement tank as the storage cistern. When the water is to be used just for landscape irrigation, only sediment filtration is typically required. When water is being collected and stored for potable uses, additional measures are required to purify the water and ensure its safety. Rainwater harvesting offers several important environmental benefits, including reduced pressure on limited water supplies and reduced stormwater runoff and flooding. It can also be a better-quality source of water than conventional sources. After purification, rainwater is usually very safe and of high quality. "Hardness" (mineral content) is low, and in areas with groundwater that is polluted, hazardous (from arsenic or other natural toxins), saline, or hard, properly purified rainwater may be a higher-quality and safer source of drinking water than water pumped out of the ground.

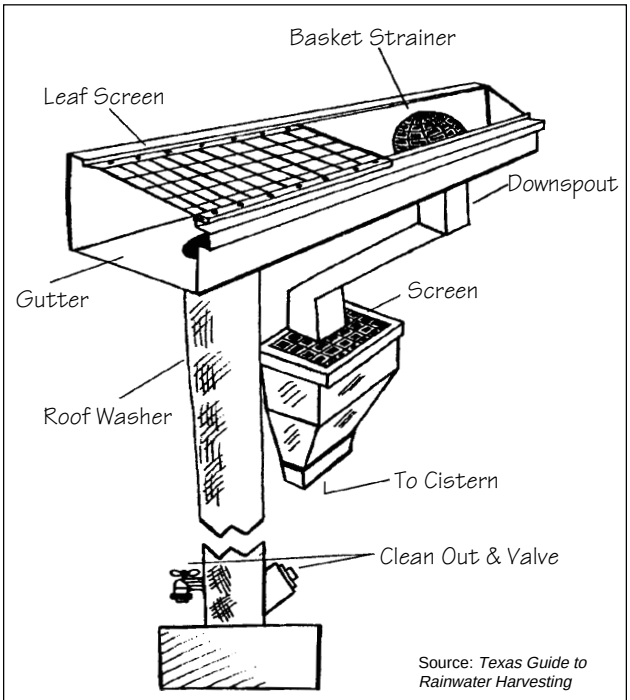
Opportunities

Consider rainwater harvesting in the following situations: (1) locations where aquifer-based water supplies are very limited or ecologically fragile (i.e., where excessive pumping of groundwater can lower the water table, threatening ecologically valuable surface waters and springs); (2) where pumped groundwater is polluted or excessively mineralized (hard) and requires extensive treatment; and (3) where stormwater runoff is a major concern. Installation of a rainwater harvesting system will be easiest if planned for in the design of a new building or considered when reroofing is planned. Though rainwater harvesting is feasible on commercial as well as residential buildings, commercial applications may be more restricted in many locations—uses may, in fact, be limited to landscape irrigation or cooling-tower use. To be viable as the sole water source for residential and small commercial applications, an average annual rainfall of at least 24 in. (600 mm) is generally required; if total annual rainfall is less than about 40 in. (1 m) per year or highly seasonal, aggressive water conservation measures will probably be required.

Technical Information

A typical rainwater harvesting system designed for potable uses has seven primary components; one of these—the roof-wash system (number 2)—may be eliminated in systems not used for potable water:

1. **Catchment area.** With most rainwater harvesting systems, the catchment area is the building's roof. The best roof surface for rainwater harvesting does not support biological growth (algae, mold, moss, etc.), is fairly smooth so that pollutants deposited on the roof are quickly removed by the "roof-wash" system, and should have minimal overhanging tree branches above it. Galvanized metal is the roofing material most commonly used for rainwater harvesting.
2. **Roof-wash system.** This is a system for keeping dust and pollutants that have settled on the roof out of the cistern. It is *necessary* for systems used as a source of potable water but also recommended for other systems since it keeps potential contaminants out of the tank. A roof-wash system is designed to purge the initial water flowing off a roof during rainfall.
3. **Prestorage filtration.** To keep large particulates, leaves, and other debris out of the cistern, a domed, stainless-steel screen should be secured over each



Source: *Texas Guide to Rainwater Harvesting*

This schematic shows the primary means of keeping leaves and pollutants out of a rainwater cistern. The roof washer fills with the first 10–20 gallons of rainfall. After it fills, water flows to a downspout leading to the cistern. After the rain ends, the roof washer is drained—or the valve can be left open slightly so that water trickles out, even during a rainstorm.

Rainwater catchment system at the U.S. Post Office in Volcano, Hawaii. Photo: Alex Wilson

inlet leading to the cistern. Leaf guards over gutters can be added in areas with significant windblown debris or overhanging trees.

4. **Rainwater conveyance.** This is the system of gutters, downspouts, and (generally plastic) pipes used to carry water from the roof to the cistern.
5. **Cistern.** This is usually the largest single investment required for a rainwater harvesting system. Typical materials used include galvanized steel, concrete, ferro-cement, fiberglass, polyethylene, and durable wood (e.g., redwood or cypress). Costs and expected lifetimes vary considerably among these options. Tanks may be located in a basement, buried outdoors, or located above ground outdoors. Light should be kept out to prevent algae growth. Cistern capacity should be sized to meet expected demand. Particularly for systems designed as the sole water supply, sizing should be modeled on the basis of 30-year precipitation records, with sufficient storage to meet demand during times of the year having little or no rainfall.
6. **Water delivery.** A pump is generally required to deliver water from the cistern to its point of use, though gravity-fed systems are occasionally possible with appropriate placement of system components.
7. **Water treatment system.** To protect plumbing and irrigation lines (especially with drip irrigation), water should be filtered through sediment cartridges to remove particulates, preferably down to 5 microns. For systems providing potable water, additional treatment is required to ensure a safe water supply. This can be provided with microfiltration, UV sterilization, reverse osmosis, or ozonation (or a combination of those methods). With some systems, higher levels of treatment are provided only at a single faucet where potable water is drawn. (If not all faucets in a building are delivering fully purified potable water, be sure to educate building occupants as to where water for drinking or cooking should be drawn.)

The town of Volcano on the Island of Hawaii is an ideal location for rainwater harvesting. Being volcanic, the land is extremely porous, so pockets of groundwater (aquifers) generally do not exist or are extremely deep. But there is plenty of rainfall—more than 60 in. (1.5 m) per year. As a result, nearly all buildings in the town, including the post office (above), harvest rainwater as their primary water source.

Costs of rainwater harvesting systems vary widely, from almost nothing (for a simple rain barrel beneath a downspout) to more than $75,000 (for a large commercial system). The greatest variability in cost has to do with the choice of a cistern. A typical rule of thumb is $1.00 per gallon ($264/m^3) of storage capacity for systems under 10,000 gallons, and $0.50 per gallon ($132/m^3) for larger systems.

References

Texas Guide to Rainwater Harvesting, Texas Water Development Board in cooperation with the Center for Maximum Potential Building Systems. Available from the Texas Water Development Board, P.O. Box 13231, Austin, TX 78711; (512) 463-7847; or downloadable online at www.twdb.state.tx.us/assistance/conservation/Rain.htm.

Contacts

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